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Spiral-Flow Apparatus for Measuring Permeation of Solids by Gases

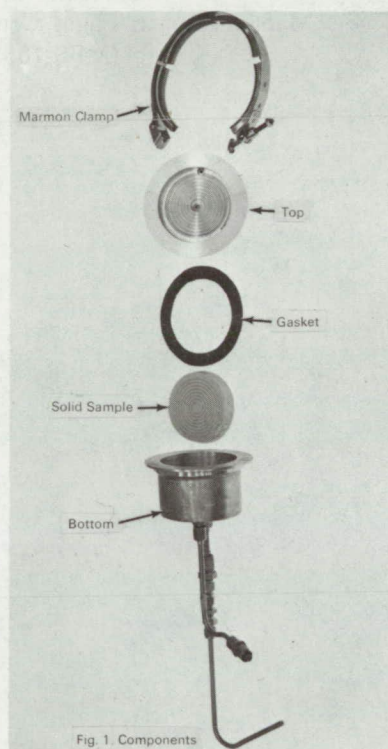


Fig. 1. Components

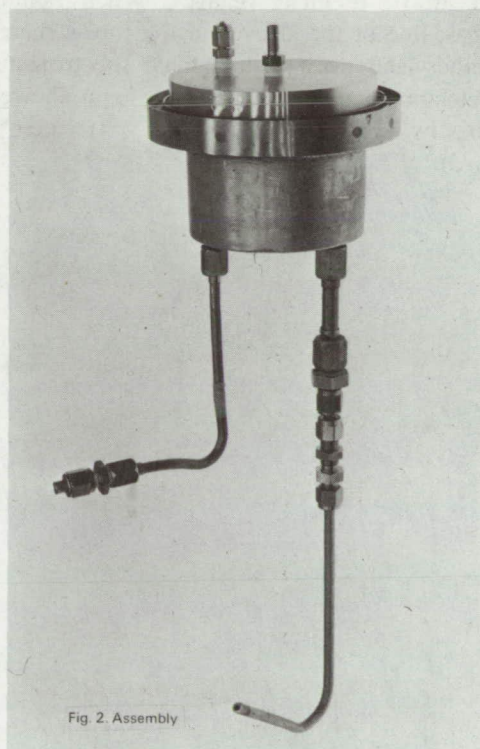


Fig. 2. Assembly

The problem:

To develop an apparatus for measuring the rate of permeation of a solid by a gas.

The solution:

A novel test assembly consisting of two portions machined from metal: (1) a shallow top and (2) a deeper bottom with matching flanges; their inner diameter is nominally 3.5 inches. In the inner face

of the top a spiral groove is machined from the periphery to the center; the groove has a knife edge. At each end of the groove a hole is drilled through the face, tapped, and fitted with a sleeve.

How it's done:

A cylindrical plug of the solid to be tested (such as a polymeric material), 3.5 inches in diameter and $\frac{7}{8}$ inch thick, is pressed into the top until the spiral

(continued overleaf)

knife edge engages its surface to a depth of 0.010 to 0.030 inch. The periphery of the plug is then sealed to the top with impermeable resin. The top and the bottom are then clamped together over a gasket with a Marmon clamp.

Under pressure the test gas is admitted to the bottom. A carrier stream of gaseous helium is passed through the outer sleeve of the top, along the spiral groove, and out through the central sleeve to a gas chromatograph that detects the presence of the test gas. Thus, the rate of permeation can be determined. Its spiral passage ensures that all of the carrier gas traverses the entire surface of the solid and that all is sampled. The minimum detectable rate of permeation is $2.5 \times 10^{-5} \text{ cm}^3/\text{sec}$ (standard).

When tested for several days continuously, samples of a fire-retardant foam were impermeable by oxygen or nitrogen at 10 lb/inch² (gauge). When helium is the test gas, one of the sleeves in the top is sealed while the other leads to a helium mass spectrometer as a leak-detector. Samples of the same foam showed permeabilities by helium of 6.2 and $7.9 \times 10^{-5} \text{ cm}^3/\text{sec}$ (standard).

Notes:

1. The device may interest manufacturers of rubber, chemicals, or instruments.
2. No further documentation is available. Inquiries may be directed to:

Technology Utilization Officer
Marshall Space Flight Center
Huntsville, Alabama 35812
Reference: B69-10357

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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